OTT's Office of Advanced Automotive Technologies

Developing exciting new car concepts

ENERGY EFFICIENCY AND RENEWABLE ENERGY

OFFICE OF TRANSPORTATION TECHNOLOGIES

Transportation

FOR THE 21ST CENTURY

The Office of Advanced Automotive Technologies (OAAT) is part of the Office of Transportation Technologies (OTT) within the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. OAAT is responsible for the research, development, and validation of energy efficient, light duty passenger vehicle technologies that could significantly reduce the nation's dependence on oil. Through its Advanced Automotive Technology (AAT) Program, OAAT is working with industry to develop advanced light duty vehicle technologies that will significantly improve fuel economy and environmental performance without sacrificing the performance, safety, and affordability we have come to rely on in today's automobiles. The AAT program emphasizes jointly-funded partnerships with industry to develop and validate these advanced technologies. This will ensure that adequate resources are applied to research and development (R&D) activities; that effective technology transfer will take place; and that government resources are leveraged with those of industry.

As the nation seeks to reduce its dependence on oil, one of the AAT program's highest priorities is to improve fuel economy and increase the use of alternative fuels in the transportation sector. Through its involvement in the Partnership for a New Generation of Vehicles (PNGV), OAAT supports the goal of developing technologies that will enable midsize passenger vehicles achieve gas mileage of up to 80 miles per gallon (mpg) by 2004 without sacrificing safety, performance, and affordability. Initiated in 1993, this partnership between the Federal government and the automotive industry has as its goal the development of highly fuel-efficient pre-production models by Ford, General Motors, and DaimlerChrysler. OAAT's role in the PNGV program is most prominent in the research, development, and validation of advanced technologies that might not be pursued by industry alone, given the substantial risk involved.

Several of the technologies being researched under the Advanced Automotive Technologies Program are described below.

Hybrid vehicles – combining two technologies to get the best of both

Hybrid electric vehicles combine two (or more) energy conversion technologies in a single vehicle. A hybrid vehicle may contain both an internal combustion engine and an electric motor powered by an advanced battery technology. OAAT is working in close cooperation with industry on research, development, testing, and evaluation activities to develop the technologies that will eventually lead to the full-scale production of electric and hybrid vehicles. Some of the projects include the development of vehicle systems, high-power energy storage, and power electronics.

Fuel cells – a high-efficiency solution

Initially developed as a power source for the space program, highly efficient fuel cells use specialized membranes and the elements hydrogen and oxygen to produce electricity. The goal of the OAAT Fuel Cells Program is to develop low or zero emission automotive fuel cell propulsion systems. Specific objectives include: By the year 2004, validate fuel cell power systems that are two to three times more energy efficient than today's comparable vehicles; that meet Federal "Tier 2" emissions standards; and that are capable of operating on hydrogen, methanol, natural gas, or gasoline. In addition, by 2008, the objective is to validate fuel cell propulsion systems that meet customer expectations in terms of cost and performance.

Improving the heat engine

Internal combustion heat engines are the powerhouse of today's automobiles and trucks, and for hybrid vehicles of the near future as well. OAAT is working with industry to improve the efficiency and emissions performance of direct injection engines through advanced research on emissions control sys-

Energy Efficiency and Renewable Energy's Office of Transportation Technologies (OTT) within the U.S. Department of Energy is charged with reducing America's dependence on petroleum, thereby bolstering the nation's energy security and improving the quality of its air. To meet that goal, OTT enters diverse, cost-shared R&D partnerships with like-minded organizations both public and private, helping develop technologies to a point where industry can commercialize them into marketable products. OTT is organized into four "sub" offices corresponding to major customer areas:

- ***The Office of Advanced Automotive Technologies develops technologies that will lead to motor vehicles with greater fuel economy and lower emissions.***
- *The Office of Heavy Vehicle Technologies focuses on improving the efficiency of diesel engines for trucks, while simultaneously reducing emissions.*
- *The Office of Fuels Development is primarily working to reduce the cost of cleaner, domestically- sourced ethanol, a renewable and easy-to-use alternative fuel.*
- *The Office of Technology Utilization is working to pave the way for market acceptance of new transportation technologies through educational, voluntary, and other practical efforts in partnership with industry stakeholders, local, and state government.*

tems. This research is being combined with improved in-cylinder combustion processes and fuel reformulation. The integrated systems approach being taken by OAAT will allow the high efficiency of direct injection engines to be maintained while meeting future emissions standards.

Advanced fuel formulations
Advanced fuels are needed to enable the integrated vehicle emission control/fuel system to meet emissions goals while increasing fuel economy. More and more attention is being focused on the effects of advanced petroleum-based fuels, such as blends with oxygenates, gas-to-liquid diesel fuels (e.g. Fischer-Tropsch), and diesel fuels with low sulfur content which show potential for reduced particulate emissions. Many of the constituents of these fuels can be made from renewable feedstocks. Research has shown that aggressive fuel reformulation may lead to reductions in engine-out emissions of up to 35% for particulates. Advanced fuels not only can improve in-cylinder combustion processes but also facilitate the application of emission control systems.

Taking weight out of the system
The auto industry has traditionally relied upon metals such as iron and steel, but replacing structural components with lightweight materials will lead to big increases in fuel economy. OAAT is working with industry in developing and validating advanced lightweight materials technologies that will significantly reduce automobile weight without compromising vehicle performance, safety, recyclability, or cost. The following lightweight materials and technologies are being targeted:

- Low-cost glass and carbon fiber composites
- Low-cost aluminum alloy sheet
- Cast lightweight metals
- Composite mixing technologies
- Magnesium and magnesium alloys

Use of these lightweight, high-performance materials will contribute to the development of automobiles that provide three times the fuel economy of today's vehicles.

Advanced battery technologies
The environmental benefits of zero-emitting electric vehicles are substantial, but current battery technologies have serious limitations. In 1991, America's leading automakers entered into an agreement to pool their technical knowledge and funding by forming the U.S. Advanced Battery Consortium (USABC). The DOE Office of Transportation Technologies signed a cooperative agreement with the consortium, and agreed to provide technical expertise and funding. This collaboration has led to improvements in lead-acid battery performance, as well as the development of new energy storage technologies, such as nickel/metal hydride, lithium ion, and lithium/polymer batteries.

For more information on the programs of the Office of Advanced Automotive Technologies, please visit our Web site at http://www.ott.doe.gov/oaat.

For more information on how DOE is helping America remain competitive in the 21st century, please contact:

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